3.1 Facility Effluent Monitoring

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Liquid effluents and airborne emissions that may contain radioactive or hazardous constituents are continually monitored on the Hanford Site. Facility operators perform the monitoring mainly through analyzing samples collected near points of release into the environment. Effluent monitoring data are evaluated to determine the degree of regulatory compliance for each facility and/or the entire site. The evaluations are also useful in assessing the effectiveness of effluent treatment and control systems and pollution-management practices. Major facilities have their own individual effluent monitoring plans, which are part of the comprehensive Hanford Site environmental monitoring plan (DOE/RL-91-50).

Measuring devices quantify most facility effluent flows, but some flows are calculated using process information. For most radioactive air emission units, effluent sampling methods include continuous sampling or periodic confirmatory measurements. For most liquid effluent streams, proportional sampling or grab sampling is used. Liquid and airborne effluents with a potential to contain radioactive materials at prescribed threshold levels are measured for gross alpha and beta activity and, as warranted, specific radionuclides. Non-radioactive constituents are either monitored or sampled, as applicable.

Small quantities of tritium, cobalt-60, strontium-90, antimony-125, iodine-129, cesium-137, plutonium-238, plutonium-239/240, plutonium-241, and americium-241 were released to the environment at state and federally permitted release points. Most of the radionuclides in effluents at the site are nearing levels indistinguishable from the low concentrations of radionuclides in the environment that occur naturally or originated from atmospheric nuclear-weapons testing. The site mission of environmental cleanup is largely responsible for the downward trend in radioactive emissions, which results in smaller radiation doses to the maximally exposed member of the public. Figures 3.1.1 and 3.1.2 show the quantity of several long-lived radionuclides released from the site over recent years. The concentrations of radioactive and non-radioactive constituents released in effluent in 2000 were less than the applicable standards.

Effluent release data are documented in several reports besides this one, and all are available to the public. For instance, the U.S. Department of Energy (DOE) annually submits to the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Health a report of radioactive airborne emissions from the site (DOE/RL-2001-32), in compliance with the Code of Federal Regulations (40 CFR 61), "National Emission Standards for Hazardous Air Pollutants," Subpart H, "National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities," and Washington Administrative Code (WAC) 246-247, "Radiation Protection—Air Emissions." Data quantifying the radioactive liquid and airborne effluents are reported to DOE annually in an environmental releases report (HNF-EP-0527-10). Monitoring results for liquid streams regulated by the National Pollutant Discharge Elimination System permit are reported to EPA. Monitoring results from liquid effluent streams regulated by WAC 173-216 are reported to the Washington State Department of Ecology. Non-radioactive air emissions are reported annually to the Washington State Department of Ecology.

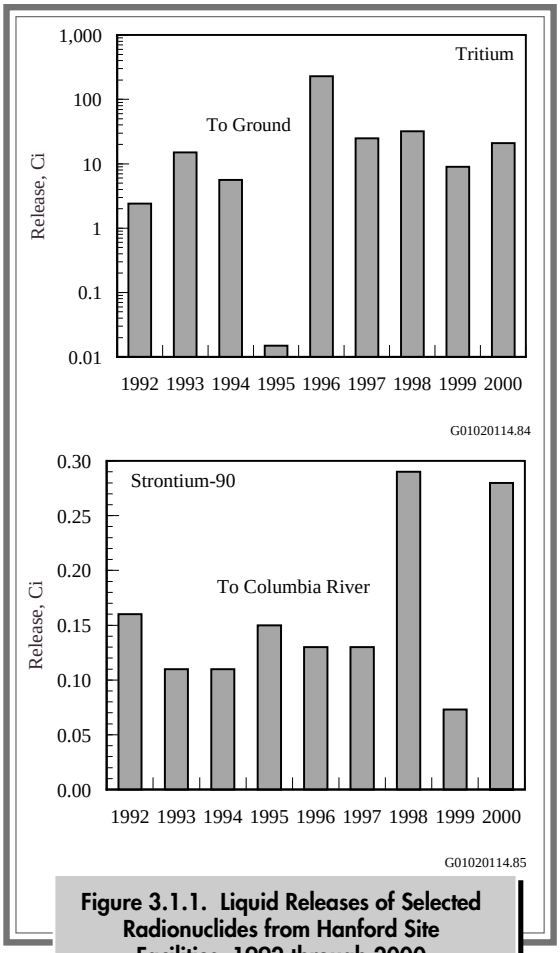

Figure 3.1.1. Liquid Releases of Selected Radionuclides from Hanford Site Facilities, 1992 through 2000

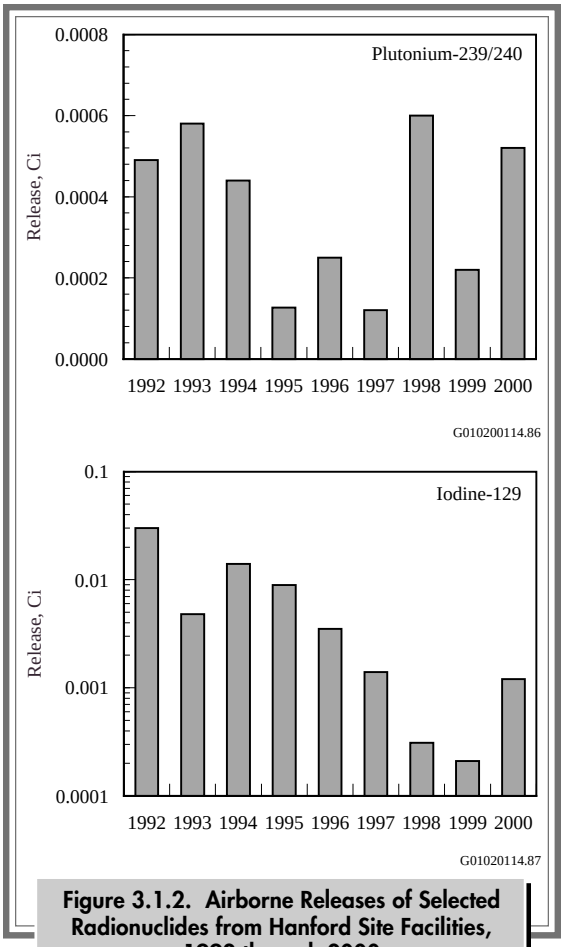

Figure 3.1.2. Airborne Releases of Selected Radionuclides from Hanford Site Facilities, 1992 through 2000

3.1.1 Radioactive Airborne Emissions

Radioactive airborne emissions from site activities contain particulate and volatile forms of radionuclides. Emissions having the potential to exceed 1% of the 10-mrem/yr standard (40 CFR 61, Subpart H) for offsite doses are monitored continuously.

The continuous monitoring of radioactive emissions involves analyzing samples collected at points of discharge to the environment, usually from a stack or a vent. Samples are analyzed for gross alpha and beta levels, as well as selected radionuclides. The selection of the specific radionuclides sampled, analyzed, and reported is based on 1) an evaluation of maximum potential of unmitigated emissions expected from known radionuclide inventories in a facility or activity area, 2) the sampling criteria given in contractor environmental compliance manuals, and 3) the potential each radionuclide has to contribute to the offsite public dose. Continuous air monitoring systems with alarms are also used at selected emission points when a potential exists for radioactive emissions to exceed normal operating ranges by levels requiring immediate personnel alert.

Radioactive emission discharge points are located in the 100, 200, 300, and 400 Areas. The sources for these emissions are summarized below.

- In the 100 Areas, emissions originated from the normal evaporation at two water-filled storage basins (100-K East and 100-K West Fuel Storage Basins, which contain irradiated nuclear fuel), the newly constructed Cold Vacuum Drying Facility, and from a low-level laboratory. In 2000, there were five points of radioactive emissions in the 100 Areas.
- In the 200 Areas, the primary sources of radionuclide emissions were the Plutonium Finishing Plant, T Plant, 222-S Laboratory, underground tanks for storage of high-level radioactive waste, waste evaporators, and the inactive Plutonium-Uranium Extraction Plant. In 2000, there were 50 points of radioactive emissions in the 200 Areas.
- The 300 Area primarily has laboratories and research facilities. Primary sources of airborne radionuclide emissions were the 324 Waste Technology Engineering Laboratory, 325 Applied Chemistry Laboratory, 327 Post-Irradiation Laboratory, and 340 Vault and Tanks. In 2000, there were 22 discharge points of radioactive emissions in the 300 Area.
- The 400 Area has the Fast Flux Test Facility (which did not operate in 2000), the Maintenance and Storage Facility, and the Fuels and Materials Examination Facility. Operations and support activities at the Fast Flux Test Facility and Maintenance and Storage Facility released small quantities of radioactive material to the environment. In 2000, there were five points of radioactive emissions in the 400 Area.
- The 600 Area has the Waste Sampling and Characterization Facility (between the 200-West and 200-East Areas), at which low-level radiological and chemical analyses of various types of samples (e.g., particulate air filters, liquids, soil, and vegetation) are performed. This facility had two points of radioactive emissions in 2000.

A summary of the Hanford Site radioactive airborne emissions in 2000 is provided in Table 3.1.1.

3.1.2 Non-Radioactive Airborne Emissions

Non-radioactive air pollutants released from power-generating and chemical processing facilities are monitored when activities at a facility are known to generate potential pollutants of concern.

In past years, gaseous ammonia was released from the Plutonium-Uranium Extraction Plant, 242-A evaporator, 241-AP tank farm, and 241-AW tank farm, all located in the 200-East Area. Ammonia emissions are tracked only when activities at these facilities are capable of generating them. In 2000, the 200 Areas tank farms produced reportable ammonia emissions, summarized in Table 3.1.2.

Onsite diesel-powered steam generating plants emitted particulate matter, sulfur oxides, nitrogen oxides, volatile organic compounds, carbon monoxide, and lead. The total annual releases of these constituents are reported in accordance with the air quality standards established in WAC 173-400. These releases to the atmosphere, listed in Table 3.1.2, do not exceed any of the ambient air quality standards. Emissions are calculated from the quantities of fossil fuel consumed, using EPA-approved formula (AP-42).

Should activities lead to chemical emissions in excess of quantities reportable under the *Comprehensive Environmental Response, Compensation, and Liability Act of 1980* (CERCLA), the release totals are reported immediately to EPA. If the emissions remain stable at predicted levels, they may be reported annually with EPA's permission. Table 3.1.2 summarizes the emissions of non-radioactive constituents in 2000. (Note: the 100, 400, and 600 Areas have no sources of non-radioactive emissions that are a regulatory concern.)

Table 3.1.1. Radionuclides Discharged to the Atmosphere at the Hanford Site, 2000

		Release, Ci[a]				
Radionuclide	**Half-Life**	**100 Areas**	**200-East Area**	**200-West Area**	**300 Area**	**400 Area**
Tritium (as HT)[b]	12.3 yr	NM[a]	NM	NM	4.3E+01	NM
Tritium (as HTO)[b]	12.3 yr	NM	NM	NM	7.9E+01	8.8E-01
Cobalt-60	5.3 yr	3.4E-08	ND[a]	ND	ND	NM
Strontium-90	29.1 yr	4.1E-05	9.1E-05[c]	1.9E-04[c]	1.0E-05[c]	NM
Technetium-99	2.13×10^5 yr	NM	NM	NM	1.7E-08	NM
Antimony-125	2.77 yr	ND	1.8E-06	ND	ND	NM
Iodine-129	1.6×10^7 yr	NM	1.2E-03	NM	NM	NM
Cesium-137	30 yr	1.1E-04	6.7E-05	2.1E-09	1.6E-06	3.5E-06[d]
Plutonium-238	87.7 yr	8.4E-07	9.8E-08	1.1E-05	7.6E-09	NM
Plutonium-239/240	2.4×10^4 yr	5.4E-06	2.5E-06[e]	5.1E-04[e]	8.2E-07[e]	NM[f]
Plutonium-241	14.4 yr	6.8E-05	6.1E-06	3.1E-04	NM	NM
Americium-241	432 yr	2.6E-06	4.8E-06	8.7E-05	3.4E-08	NM
Americium-243	7,380 yr	NM	NM	NM	ND	NM

(a) 1 Ci = 3.7E+10 becquerel; ND = not detected (i.e., either the radionuclide was not detected in any sample during the year or the average of all the measurements for that given radionuclide or type of radioactivity made during the year was below background levels); NM = not measured.
(b) HT = Elemental tritium; HTO = tritiated water vapor.
(c) This value includes gross beta release data. Gross beta and unspecified beta results were assumed to be strontium-90 in dose calculations.
(d) This value includes gross beta release data. Gross beta results were assumed to be cesium-137 in dose calculations.
(e) This value includes gross alpha release data. Gross alpha and unspecified alpha results were assumed to be plutonium-239/240 for dose calculations.
(f) Analyses were conducted for gross beta activity, but none was detected. If detected, it would have been assumed to be plutonium-239/240 for dose calculations.

3.1.3 Radioactive Liquid Effluents

Liquid effluents are discharged from facilities in all areas of the Hanford Site. Effluents that normally or potentially contain radionuclides include cooling water, steam condensates, process condensates, and wastewater from laboratories and chemical sewers. These wastewater streams are sampled and analyzed for gross alpha and beta levels, as well as selected radionuclides.

In 2000, only facilities in the 200 Areas discharged radioactive liquid effluents to the ground that went to a single location, the 616-A crib, also known as the State-Approved Land Disposal Site. A summary of radioactive liquid effluents is provided in Table 3.1.3. Table 3.1.4 summarizes data on radionuclides in liquid effluents released from the 100 Areas to the Columbia River, the sources of which include secondary cooling water used at the 100-K Basins and the shoreline seepage of groundwater that has passed near the retired 1301-N and 1325-N cribs in the 100-N Area. These measurements are used to determine potential radiation doses to the public (see Section 6.0).

Table 3.1.2. Non-Radioactive Constituents Discharged to the Atmosphere at the Hanford Site, 2000[a,b]

Constituent	Release, kg (lb) 200 Areas		300 Area	
Particulate matter	900	(1,984)	677	(1,477)
Nitrogen oxides	24,000	(52,920)	3,500	(7,717)
Sulfur oxides	3,400	(7,497)	29	(64)
Carbon monoxide	18,000	(39,690)	12,000	(26,460)
Lead	0.53	(1.2)	0.0	(0.0)
Volatile organic compounds[c]	5,700	(12,569)	800	(1,764)
Ammonia[d]	12,000	(26,460)	NE[e]	
Other toxic air pollutants[f]	2,500	(5,512)	NE	

(a) The estimate of volatile organic compounds does not include emissions from certain laboratory operations.
(b) None of these releases exceed any of the ambient air quality standards.
(c) Produced from burning fossil fuel for steam and electrical generators, calculated estimates from the 200-East and 200-West Area tank farms, and operation of the 242-A evaporator and the 200 Areas Effluent Treatment Facility.
(d) Ammonia releases are calculated estimates from the 200-East and 200-West Area tank farms and operation of the 242-A evaporator and the 200 Areas Effluent Treatment Facility.
(e) NE = No emissions.
(f) Releases are a composite of calculated estimates of toxic air pollutants, excluding ammonia, from the 200-East and 200-West Area tank farms, and operation of the 242-A evaporator and the 200 Areas Effluent Treatment Facility.

Table 3.1.3. Radionuclides in Liquid Effluents from the 200 Areas Discharged to the State-Approved Land Disposal Site, 2000

Radionuclide	Half-Life	Release, Ci
Tritium	12.3 yr	21

Table 3.1.4. Radionuclides in Liquid Effluents from the 100 Areas Discharged to the Columbia River, 2000

Radionuclide	Half-Life	Release, Ci
Tritium	12.3 yr	0.15
Strontium-90	29.1 yr	0.28
Plutonium-238	87.7 yr	0.0000092
Plutonium-239/240	2.4×10^4 yr	0.000039
Americium-241	432 yr	0.0000079

3.1.4 Non-Radioactive Hazardous Materials in Liquid Effluents

Non-radioactive hazardous materials in liquid effluent are monitored in the 100, 200, 300, and 400 Areas. These effluents are discharged to the State-Approved Land Disposal Site and to the Columbia River. Effluents entering the environment

at designated discharge points are sampled and analyzed to determine compliance with the National Pollutant Discharge Elimination System permits and the state waste discharge permits for the site (40 CFR 122 and WAC 173-216). Should chemicals in liquid effluents exceed quantities reportable under CERCLA, the release totals are reported immediately to the EPA. If emissions remain stable at predicted levels, they may be reported annually with the EPA's permission. A synopsis of the National Pollutant Discharge Elimination System and state waste discharge permit violations in 2000 is given in Section 2.2.8.

Liquid waste containing both radioactive and hazardous constituents are stored at the 200 Areas in underground waste storage tanks or monitored interim storage facilities.

3.1.5 CERCLA and Washington Administrative Code Releases to the Environment

Releases that are reportable to the state and/or EPA include spills or discharges of hazardous substances or dangerous waste to the environment, other than releases permitted under state or federal law. Accidents and equipment failures cause the majority of these releases. Releases of hazardous substances that are continuous and stable in quantity and rate but that exceed specified limits must be reported as required by Section 103(f)(2) of CERCLA.

Spills or non-permitted discharges of dangerous wastes or hazardous substances to the environment are required to be reported (WAC 173-303-145). This requirement applies to spills or discharges onto the ground, into the groundwater, into the surface water (e.g., Columbia River), or into the air that may threaten human health or the environment, regardless of the quantity of dangerous waste or hazardous substance.

With both CERCLA and Washington Administrative Code reporting requirements in view, one release in 2000 was reported in accordance with WAC 173-303-145. Table 3.1.5 contains a synopsis of this release.

Table 3.1.5. Reportable Releases to the Environment at the Hanford Site, 2000

Material	Quantity	Location
Airborne radionuclides	3.6E-05 Ci of plutonium-239/240, potential	During a routine functional test of the 291-Z-1 stack constant air monitor at the Plutonium Finishing Plant in the 200-West Area, a plant worker accidentally dropped a wrench onto the constant air monitor causing it to annunciate. The record sample filter was analyzed, but the results were determined to be only a potential release, since the higher activity on the filter that triggered the alarm likely originated from radioactive material that had gradually deposited within the sampling line leading to the filter during the normal course of operations, spanning years.